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## Complex adaptive systems science meets systems engineering

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Recently in an effort to not only improve military training CGFs but to also establish a capability to rapidly develop agent-based models for multitude of uses to support the warfighter, the Air Force Research Lab 711/HPW Warfighter Readiness Research Division, along with a few partners from industry, developed, facilitated and promoted a “Not-So-Grand-Challenge” (NSGC) effort. In this article we report the methods employed to develop, integrate, and test complex adaptive agent-based models in a complex training research environment, the use-case as applied. To do so, we capitalized on the properties of complex adaptive situations, context-based agent-based modeling, and the utility of modularization and/or decomposition of an agent or system’s functional properties. We found that development and use of Knowledge-to-Model (k2Mod) Environment Abstraction (EA) architecture gives agents the capacity to recognize gain situation awareness, recognize change in their environment, and react appropriately. This method also facilitates the speed by which new agent definitions can be developed. In addition, formalizing such a protocol affords the Modeling and Simulation community a process that promotes portability, usability, reusability and composability for rapid agent-based modeling development in complex environments.

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## Controlled fracture of the soda-lime glass in laser thermal cleavage

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The effects of the contact ball-lens on the soda lime glass in laser thermal cleavage with a cwNd-YAG laser were investigated in this study. A contact ball-lens was adopted to generate a bending force on the crack formation of the soda-lime glass in the laser cutting process. The Nd-YAG laser beam (wavelength of 1064 nm) was focused through the ball-lens and transmitted to the soda-lime glass, which was coated with a carbon film on the surface with a bending force from a ball-lens to generate a tensile stress state on the surface cracking. The fracture was controlled by the contact ball-lens and a straight cutting was tested to demonstrate the feasibility. Experimental observations on the crack propagation from the leading edge, main section and trailing edge of the glass sheet were compared with various mechanical and thermal loadings. Further analyses on the stress under various laser powers and contact ball loadings were made to characterize the innovative technology. The results show that the distributions of the side crack at the leading and trailing edges are mainly dependent on the boundary condition, contact force, cutting speed and laser power. With the increase of the mechanical and thermal loadings, the region of the side cracks might be dramatically reduced with proper selection of the geometrical constrains. Therefore the application of the contact ball-lens is a possible way to control the fracture in laser cleavage with improved cutting qualities.

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